

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2004-235072

(43)Date of publication of application : 19.08.2004

(51)Int.Cl.

H01J 61/067

(21)Application number : 2003-
023939

(71)Applicant : NEOMAX CO LTD

(22)Date of filing :

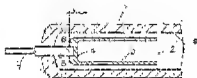
31.01.2003

(72)Inventor : SHIOMI KAZUHIRO

ISHIO MASAOKI

MATSUBARA SHIGEJI

(54) ELECTRODE ALLOY FOR FLUORESCENT DISCHARGE TUBE,
ELECTRODE FOR THE FLUORESCENT DISCHARGE TUBE AND THE
FLUORESCENT DISCHARGE TUBE PROVIDED WITH THE ELECTRODE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electrode alloy for fluorescent discharge tube, improving the brightness of a lamp and superior in its moldability, an electrode for fluorescent discharge tube and a fluorescent discharge tube provided with the electrode.

SOLUTION: The electrode alloy for the fluorescent discharge tube is formed by Ni-W alloy containing 2.0 to 10 mass% of W and the remainder substantially from Ni, Ni-W-Nb alloy, Ni-W-Ta alloy or Ni-W-Nb-Ta alloy containing 2.0 to 6.0 mass% of W and 0.5 to 2.0 mass% in total weight of one or two type(s) of elements of either Nb or Ta and the remainder substantially from Ni. The electrode for the fluorescent discharge tube 2 is formed by the electrode alloy and is provided with a tube part 3 with one end open and an end plate part 4 sealing the other end of the tube part 3. The end plate part 4 is formed thicker than the tube wall thickness of the tube part 3. In the end plate part 4, a recessed part 6 for aligning a conductor for power feeding can be formed into a concentric state to the tube part 3.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's
decision of rejection]

[Kind of final disposal of application
other than the examiner's decision of
rejection or application converted
registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's
decision of rejection]

[Date of requesting appeal against
examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]

W -- 2.0 - 10mass% -- containing -- the remainder -- the electrode alloy for the fluorescence discharge tubes which consists of nickel substantially.

[Claim 2]

one sort or two sorts of elements chosen from 2.0 - 6.0mass, and Nb and Ta in W -- the total quantity -- 0.5 - 2.0mass% -- containing -- the remainder -- the electrode alloy for the fluorescence discharge tubes which consists of nickel substantially.

[Claim 3]

It is the electrode for the fluorescence discharge tubes equipped with the tube part from which the end was released, and the end plate section which blockades the other end of said tube part,

The electrode for the fluorescence discharge tubes in which it was fabricated in one and the wall-thickness halfbeak of a tube part was also thickly formed for said end plate section with the electrode alloy which said tube part and end plate section indicated to claims 1 or 2.

[Claim 4]

Said end plate section is the electrode for the fluorescence discharge tubes indicated by claim 3 by which said tube part and the crevice for conductor positioning arranged concentrically were established in the outside.

[Claim 5]

It is the fluorescence discharge tube equipped with the electrode of a couple which the fluorescent screen was formed in the internal surface, has been arranged the glass tube with which the gas for discharge was enclosed with the interior, the conductor for feed closed by the both ends of the glass tube in the shape of penetration a glass tube, concentric, and within and without the glass tube, and inside said glass tube, and was connected to the edge of said conductor for feed,

The fluorescence discharge tube with which the electrode for the fluorescence discharge tubes indicated by claims 3 or 4 as said electrode was used, and joining of said conductor for feed was concentrically carried out to the outside of the end plate section of said electrode.

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs]

This invention relates to the fluorescence discharge tube used as a back light of liquid crystal, its electrode, and electrode material.

[0002]

[Description of the Prior Art]

The fluorescence discharge tube small as a back light is used for liquid crystal equipment. The fluorescent screen (graphic display abbreviation) was formed in the internal surface, and this fluorescence discharge tube is equipped with the glass tube 11 with which the gas for discharge (rare gas and mercury vapour, such as argon gas) was enclosed with the interior, and the electrode 12 which constitutes the cold cathode of the couple prepared in the both ends of the glass tube 11, as shown in drawing 3. Said electrode 12 is formed in one in the shape of a cylinder like object with base of the tubed tube part 13 from which the end was released, and the end plate section 14 which blockades the other end of this tube part 13. The end of the conductor 15 of the shape of a rod closed so that the edge of said glass tube 11 might be penetrated is welded to said end plate section 14, and lead wire 17 is connected to the other end of this conductor 15.

[0003]

Said electrode 12 is conventionally formed with pure nickel, and the size is [which has a small back light etc.] for the fluorescence discharge tubes about 0.1mm in the bore of about 1.5mm, the overall length of about 5mm, and thickness of a wall 13, for example. This tubed electrode is fabricated in one by carrying out deep-drawing shaping of the pure nickel sheet metal which usually has thickness equivalent to the thickness of said tube part.

[0004]

As a technique about the electrode for the fluorescence discharge tubes, in order to raise a lamp life, forming an electrode with Nb, Ti, low Ta, or these low alloys of a sputtering yield is indicated by JP,2002-110085,A (patent reference 1).

However, an expensive top, these high-melting oxidizing quality metals need to manufacture bulk material by different special approaches from usual dissolution and casting, such as a plasma-arc-melting method and powder-metallurgy processing, and have the problem that fabricating-operation nature is dramatically bad and cannot carry out a fabricating operation to a tubed electrode easily like pure nickel further as compared with pure nickel.

[Patent reference 1]

JP,2000-3973,A (claim)

[0005]

[Problem(s) to be Solved by the Invention]

Although the electrode for the fluorescence discharge tubes mainly had the good moldability as above-mentioned and it was formed with pure nickel stable also in construction material, improvement in brightness is called for with the miniaturization of the fluorescence discharge tube. Although what is necessary is just to lower the pressure of the gas for discharge (rare gas) enclosed with the discharge tube in order to raise brightness, it becomes easy to produce the phenomenon (sputtering) which ion etc. collides and emits an atom to an electrode from an electrode metal in the case of burning. Consequently, since the atom of an electrode metal combines with the mercury enclosed in the glass tube and mercury vapour is exhausted, there is a problem that a lamp life falls.

Moreover, since the end plate section has only thickness equivalent to a tubed body, the conventional tubed electrode has a severe welding condition at the time of welding the conductor for feed, and poor joining tends to produce it. For this reason, there is a problem of the electric and thermal junction to an electrode becoming uncertain, a discharge condition and a heat dissipation condition becoming unstable, and the brightness of the fluorescence discharge tube falling, and becoming easy for a lamp life to fall.

This invention was made in view of this problem, is excellent in fabricating-operation nature, and aims at offering the electrode for the fluorescence discharge tubes which can prevent lowering of the brightness resulting from

offering the electrode alloy for the fluorescence discharge tubes which can moreover raise the brightness of the discharge tube, and poor joining of the conductor for feed, and lowering of a lamp life, and offering the fluorescence discharge tube further equipped with the above-mentioned description.

[0006]

[Means for Solving the Problem]

the electrode alloy for the fluorescence discharge tubes by this invention -- W -- 2.0 - 10mass% -- containing -- the remainder -- the nickel-W alloy which consists of nickel substantially, or W -- any one sort or two sorts of elements, 2.0 - 6.0mass%, and Nb and Ta, -- 0.5 - 2.0mass% -- containing -- the remainder -- it is formed with the nickel-W-Nb alloy, nickel-W-Ta alloy, or nickel-W-Nb-Ta alloy which consists of nickel substantially.

[0007]

The brightness of the fluorescence discharge tube can be raised under the same discharge conditions, securing the fabricating-operation nature which does not have inferiority in nickel practically to pure nickel at that of optimum dose **** in W excellent in the electron emission characteristic according to this electrode alloy. Moreover, the sputtering yield of an electrode can be reduced and a lamp life improves [add / two sorts / one sort or / of Nb and Ta / with 0.5 - 2.0mass% / slightly]. Since the extent is larger than W about 2 times, to Nb and Ta also degrade fabricating-operation nature, and carry out compound addition of these elements with W, it is necessary to make the upper limit of the amount of W 6.0%.

[0008]

Moreover, the electrode for the fluorescence discharge tubes by this invention is equipped with the tube part from which the end was released, and the end plate section which blockades the other end of said tube part, said tube part and end plate section are fabricated in one with said electrode alloy, and the wall-thickness halfbeak of a tube part is also thickly formed for said end plate section.

[0009]

Since according to this electrode the thickness of the end plate section to which

joining of the conductor for feed is carried out is formed more thickly than the thickness of the tube wall of a tube part even if it is the case that the thickness of the tube wall of a tube part is thin In case the edge of said conductor is end plate welded in the shape of comparison, the edge of a conductor can be end plate welded easily, without performing delicate control of joining outputs, such as a welding output, and both poor joining can be prevented. For this reason, the electric and thermal junction to a conductor and an electrode becomes certain, a discharge condition and a heat dissipation condition are stabilized, and the brightness of the fluorescence discharge tube and lowering of a lamp life can be prevented. Moreover, the manufacture yield of the fluorescence discharge tube can be raised.

[0010]
 In said electrode, it is desirable to establish said tube part and the crevice for conductor positioning arranged concentrically in the outside of said end plate section. By preparing this crevice for conductor positioning, a conductor can certainly be concentrically end plate welded [of an electrode] only by inserting the edge of a conductor in said crevice and welding it. For this reason, by closing a conductor concentrically at the edge of a glass tube, an electrode and a glass tube can be arranged concentrically, the homogeneity of the discharge condition in a glass tube and stability can improve, and a lamp life can be raised more.

[0011]

Moreover, since said electrode is formed with the alloy for electrodes concerning above-mentioned this invention (a nickel-W alloy, a nickel-W-Nb alloy, a nickel-W-Ta alloy, or nickel-W-Nb-Ta alloy), it can raise lamp brightness according to an operation of W which could really fabricate by the fabricating-operation nature which was excellent in the electrode alloy, and was excellent in the electron emission characteristic.

[0012]

Moreover, the glass tube with which, as for the fluorescence discharge tube by this invention, the fluorescent screen was formed in the internal surface, and the

gas for discharge was enclosed with the interior, The conductor for feed closed by the both ends of the glass tube in the shape of penetration a glass tube, concentric, and within and without the glass tube, It is arranged inside said glass tube, the electrode for the fluorescence discharge tubes which is the fluorescence discharge tube equipped with the electrode of a couple connected to the edge of said conductor for feed, and is built over above-mentioned this invention as said electrode is used, and joining of said conductor for feed is concentrically carried out to the outside of the end plate section of said electrode. According to this fluorescence discharge tube, it has each effectiveness by the electrode concerning above-mentioned this invention.

[0013]

[Embodiment of the Invention]

the electrode alloy of this invention -- W -- 2.0 - 10mass% -- it contains and consists of a nickel-W alloy which consists of the remainder nickel and an unescapable impurity. this alloy -- the amount of W -- 2.0 - 6.0mass% -- carrying out -- a kind of Nb and Ta, or two sorts -- the total quantity -- 0.5 - 2.0mass% -- it can contain and can consider as a nickel-W-Nb alloy, a nickel-W-Ta alloy, or a nickel-W-Nb-Ta alloy (the nickel-W alloy containing these Nb(s) and Ta may also only be hereafter called nickel-W alloy).

[0014]

The electron emission characteristic of the metallic element which forms an electrode is expressed by the saturation thermionic current (I_0) generally searched for by the following formula (formula of Richardson-Dushman), and it excels in the electron emission characteristic, so that I_0 is large. If I_0 has a work function ϕ and a fixed absolute temperature T so that clearly from the following formula, the electron emission characteristic will improve, so that the number A of dash men is large. About a work function ϕ , 4.5eV and W have nickel almost equivalent to 4.6eV, and nickel is [30 and W of the number A of dash men] 70. this -- the electron emission characteristic -- W -- nickel -- a certain thing is understood more than twice. Since the temperature of the back light of the

fluorescence discharge tube, for example, liquid crystal equipment, is regularity (600 degrees C), the amount of electron emission of a nickel-W alloy increases, and its brightness improves, so that the amount of electron emission of the nickel-W alloy in the temperature is higher than nickel and there are many amounts of W. Since too little [at less than 2.0% / the improvement operation in brightness], the amount of W makes the minimum of the amount of W 3.0% preferably 2.0% in this invention.

$$I_0 = AT^2 \exp(-\phi/kT)$$

However, T: absolute temperature, ϕ : work function, k: Boltzmann's constant
[0015]

On the other hand, W reduces the fabricating-operation nature of nickel. If the amount of W exceeds 10% so that clearly from the below-mentioned example, fabricating-operation nature will fall, and it becomes difficult to really fabricate a tubed electrode with impact shaping (closed flange between the colds). For this reason, the upper limit of the amount of W is preferably made into 8% 10%.

[0016]

Nb and Ta are elements which reduce a sputtering yield and have effectiveness in improvement in a lamp life. this invention person only adds these elements slightly into a nickel-W alloy, and did the knowledge of a sputtering yield falling substantially as compared with an addition. At less than 0.5%, since too little [the lowering operation of a sputtering yield], a kind of Nb and Ta or two sorts of total quantities make the minimum of an addition (total quantity) 1.0% preferably 0.5%. On the other hand, if these elements degrade fabricating-operation nature about 2 times as compared with W according to the experiment of an artificer and an addition exceeds 2.0%, when carrying out compound addition of the W, degradation of fabricating-operation nature becomes remarkable. For this reason, the upper limit of an addition (total quantity) is preferably made into 1.5% 2.0%. When adding Nb and Ta, in consideration of degradation of the fabricating-operation nature by these elements, the upper limit of addition of the amount of W is preferably made into 5.0% 6.0%. In addition, the Ta of the reduction

effectiveness of a sputtering yield is larger than Nb so that clearly from the below-mentioned example.

[0017]

Although said electrode alloy contains a high-melting difficulty workability element, after it hot-rolls the casting piece under atmospheric air after casting it under atmospheric air, since it is extremely excellent in a moldability and workability and anneals it under an inert atmosphere like pure nickel if needed, it is easily processible into an about 0.1mm sheet by cold-rolling. And after carrying out finish annealing (softening) if needed, a tubed electrode can be manufactured by carrying out draw forming of said sheet. Moreover, after processing a casting piece into a bar with hot rolling or hot forging, carrying out wire drawing of this, cutting the obtained wire rod to proper die length, obtaining a minor-axis-like raw material (it is called a slag.) and carrying out finish annealing if needed, a tubed electrode can be obtained by carrying out impact shaping of this. When carrying out impact shaping, board thickness of the end plate section of a tubed electrode can be easily thickened as compared with a tubed part, the crevice for conductor positioning can really be easily fabricated in the end plate section further again, and it excels in productivity. in addition, finish annealing -- about 800-950 degrees C -- 3min from -- what is necessary is just to carry out 3hr extent maintenance Although what is necessary is just to perform an annealing ambient atmosphere in a hydrogen gas ambient atmosphere with the nickel-W alloy which does not contain Nb and Ta, when Nb and Ta are included, since it oxidizes and is easy to nitride these elements, it is desirable [elements] to carry out in inert gas ambient atmospheres, such as a vacuum ambient atmosphere or Ar.

[0018]

Next, the fluorescence discharge tube concerning the operation gestalt of this invention and its electrode are explained. Drawing 1 is the important section sectional view of the fluorescence discharge tube concerning an operation gestalt, the fluorescent screen 8 was formed in the internal surface, and this fluorescence discharge tube is equipped with the glass tube 1 with which the gas

for discharge (rare gas and mercury vapour, such as argon gas) was enclosed, and the electrode 2 which constitutes the cold cathode of the couple prepared in the both ends of that glass tube 1.

[0019]

Said electrode 2 is formed in [the tube part 3 from which the end was released, and the end plate section 4 which blockades the end of this tube part 3] one.

The crevice 6 for conductor positioning where fitting of the end of said conductor 5 is carried out is formed in said end plate section 4 so that rod-like the conductor 5 and said tube part 3 for feed may be arranged concentrically. Said conductor 5 is closed so that the edge of a glass tube 1 may be penetrated in and abroad, fitting of the edge inside a glass tube 1 is carried out to said crevice 6, and joining is carried out by laser welding, resistance welding, soldering, etc. in the boundary periphery section with the end plate section 4. The lead wire 7 for feed is connected to the other end of said conductor 5 located in the outside of said glass tube 1.

[0020]

While the thickness (thickness [of the part where joining of the conductor 5 is carried out] t) of said end plate section 4 forms said crevice 6, the thick twist of the tube wall of said tube part 3 is also thickly formed so that a conductor 5 can be end plate welded [4] enough. In the small fluorescence discharge tube, the thickness of about 4-10mm and a tube part 3 is formed in about 0.08-0.2mm for the die length of an electrode 2, and the thickness of said end plate section 4 is formed in about 3 to 10 thick times of said tube part 3. In addition, the depth of the crevice 6 in the end plate section 4 is preferably good to make it into twice [more than] tube wall thickness more than the tube wall thickness of a tube part 3, and there should just be thickness of the base of a crevice 6 and a tube part side inner surface more than thick extent of a tube wall.

[0021]

Although said electrode 2 can be formed with pure nickel, it is desirable to form with said nickel-W alloy for electrodes. While having the cold-forming nature of

pure nickel and equivalent extent by using said nickel-W alloy, the brightness of the fluorescence discharge tube can be raised. Furthermore, when Nb and Ta are included, a sputtering yield can be reduced and a lamp life can be raised. This tubed electrode is really fabricated by impact shaping.

[0022]

Although the above-mentioned operation gestalt showed the example in which the crevice 6 for conductor positioning was really fabricated by the end plate section 4, said crevice 6 is not necessarily needed. But since a conductor 5 and the tube part 3 of an electrode 2 are concentrically arranged by forming said crevice 6, by closing said conductor 5 concentrically to a glass tube 1, an electrode 2 and a glass tube 1 can be arranged easily concentrically, ununiformity-ization of a discharge condition can be prevented, and stabilization of discharge and improvement in a lamp life can be aimed at.

[0023]

Although an example is given and this invention is explained more concretely hereafter, this invention is not restrictively interpreted according to this example.

[0024]

[Example]

The nickel-W alloy of the presentation shown in a table 1 was dissolved at 1500 degrees C with the vacuum induction furnace, after carrying out hot forging of the casting piece which cast the molten metal at 1100 degrees C in atmospheric air, it hot-rolled at the rolling initiation temperature of 1100 degrees C, and the hot-rolling plate and the hot-rolling wire rod were obtained. It was annealed in the mixed gas (atmospheric pressure) of nitrogen and hydrogen (it holds 2 hr at 900 degrees C), cold rolling and cold drawing were given, and these hot-rolling material was processed into the sheet metal which is 0.1mm of board thickness, and a wire rod with an outer diameter [ϕ] of 1.7mm. Workability and a sputtering yield were measured using these samples.

[0025]

Workability was evaluated by the impact shaping trial and the compression test

about the nickel-W alloy which does not contain Nb and Ta. Moreover, the compression test result estimated the impact moldability of the nickel-W alloy containing Nb and Ta.

[0026]

The impact shaping trial cut said wire rod to the slag with a die length of 1.8mm, and was performed by fabricating actually a tubed electrode with bore 1.5mmphi shown in drawing 2 using this after finish annealing (it holds 2 hr at 900 degrees C under a vacuum ambient atmosphere), outer-diameter 1.7mmphi, an overall length [of 5.4mm], and a crevice depth [for conductor positioning] of 0.2mm. Punch of the used die is outer-diameter 1.5mmphi, 150 degrees of point aperture angles, and construction material die steel (SKD11). On the other hand, bores of a die are 1.7mmphi and construction material cemented carbide (D kind No. 6). since it is at the attainment event, and the die was damaged or punch deformed assessment of an impact moldability before the count of shaping reached 1000 shots or, the thing shaping became impossible cannot be fabricated for it -- when (x) and said shots per hour are reached, neither breakage of a die nor deformation of punch arises, but shaping of what was further able to be fabricated is possible -- it considered as (O).

[0027]

The compression test added the load of 1470MPa(s) (150kgf/mm²) to the shaft orientations of said slag, and asked for compressibility (%) by the following type. Compressibility =(slag die length after application of pressure)/(slag die length before application of pressure) x100

[0028]

Moreover, the sputtering yield was measured by the following points. nickel alloy sheet metal blank test piece (10mmx10mm) was extracted, and mirror polishing of the trial side was carried out. Using ion beam equipment (the product made from Veeco, type:VE-747), said test piece was used as the target, the electrical potential difference (500V) was impressed between the target and the substrate, the trial side was made to carry out an acceleration collision, and sputtering of

the fixed time amount (30min) argon ion (1.3×10^{-6} Torr) was carried out to it. The non-sputter section which masked a part of mirror plane is formed in the trial side, and a level difference is formed in the boundary of the sputter section from which the mirror plane section of a test piece was deleted by sputtering after sputtering, and the masked non-sputter section. This level difference was measured using the contact process relative roughness meter (product [made from Sloan], and type:DEKTAK2A), and it asked for the sputtering yield (%) from the following formula.

Sputtering yield = level difference (A) / spatter time amount (30min) x100

[0029]

The compressibility for which it asked as mentioned above, an impact moldability, and a sputtering yield are collectively shown in a table 1. In addition, for a comparison, the bulk material of pure nickel is prepared and the sputtering yield for which it asked by carrying out sputtering on the same conditions as the above using this is also shown collectively.

[0030]

[A table 1]

試料 No.	組 成 mass%				圧縮率 %	インパクト 成形性	スパッタ率 %	備 考
	W	N b	T a	N i				
1	1.0	—	—	残	50	○	218	比較例
2	2.0	—	—	残	50	○	217	発明例
3	4.0	—	—	残	50	○	196	〃
4	6.0	—	—	残	52	○	210	〃
5	8.0	—	—	残	53	○	208	
6	10.0	—	—	残	55	○	205	〃
7	12.0	—	—	残	57	×	210	比較例
8	5.0	1.0	—	残	54	(○)	185	発明例
9	5.0	—	1.0	残	53	(○)	130	〃
10	4.0	0.7	0.7	残	55	(○)	145	〃
11	—	—	—	100	—	—	214	比較例

[0031]

From a table 1, it is sample No. According to each sample of the nickel-W alloy of 1-8, the amount of W is excellent in the impact moldability to a small tubed electrode at 10.0% or less. A sputtering yield is Nb and Ta although it is pure Nb and equivalent extent Added slight sample No. In 8-10, it turns out that it is falling 10% or more to pure nickel. Moreover, sample No. With the nickel-W alloy containing Nb of 8-10, and Ta, the compressibility is 55% or less, and is sample No. From the relation between the compressibility of 1-7, and an impact moldability, the impact moldability which was excellent also in these samples is expectable.

[0032]

[Effect of the Invention]

The electrode alloy of this invention can raise the brightness of the fluorescence discharge tube as compared with pure nickel, without making nickel contain W

1.0 to 10%, and spoiling the fabricating-operation nature to impact shaping etc. Moreover, when W makes Nb and Ta contain slightly further under 1.0 - 6.0%, it can have the property of said nickel-W alloy, a sputtering yield can be further reduced substantially as compared with an addition, and a lamp life can be improved. Moreover, since the thickness of the end plate section is formed more thickly than the tube wall thickness of a tube part, joining of the conductor for feed can become easy, the electric and thermal junction to an electrode can become certain, and a discharge condition and a heat dissipation condition can be stabilized by the electrode of this invention, and it can prevent lowering of the brightness of the fluorescence discharge tube, and a lamp life, and can raise the manufacture yield of the fluorescence discharge tube.

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the fluorescence discharge tube equipped with the electrode for the fluorescence discharge tubes concerning the operation gestalt of this invention.

[Drawing 2] It is the sectional view of the electrode for the fluorescence discharge tubes which carried out impact shaping in the example of this invention.

[Drawing 3] It is the important section sectional view of the fluorescence discharge tube equipped with the conventional electrode for the fluorescence discharge tubes.

[Description of Notations]

1 Glass Tube

2 Electrode

3 Tube Part

4 End Plate Section

5 Conductor

6 Crevice for Conductor Positioning

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.

2. **** shows the word which can not be translated.

3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the fluorescence discharge tube equipped with the electrode for the fluorescence discharge tubes concerning the operation gestalt of this invention.

[Drawing 2] It is the sectional view of the electrode for the fluorescence discharge tubes which carried out impact shaping in the example of this invention.

[Drawing 3] It is the important section sectional view of the fluorescence discharge tube equipped with the conventional electrode for the fluorescence discharge tubes.

[Description of Notations]

1 Glass Tube

2 Electrode

3 Tube Part

4 End Plate Section

5 Conductor

6 Crevice for Conductor Positioning

[Translation done.]

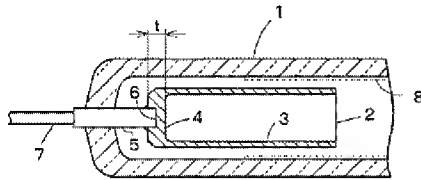
* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

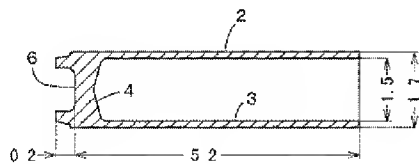
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

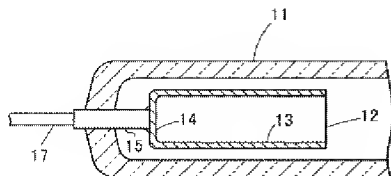
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

(11) 特許出願公開番号

特開2004-235072

(P2004-235072A)

(43) 公開日 平成16年8月19日(2004.8.19)

(51) Int. Cl.⁷

H O 1 J 61/067

F I

HO 1 J 61/067

L

テーマコード (参考)

5C015

審査請求 未請求 請求項の数 5 O L (全 8 頁)

(21) 出願番号 特願2003-23939 (P2003-23939)

(22) 出願日 平成15年1月31日 (2003. 1. 31)

(71) 出願人 000183417

株式会社NEOMAX

大阪府大阪市中央区北浜4丁目7番19号

(74) 代理人 100101395

弁理士 本田 ▲龍▼雄

(72) 発明者 塩見 和弘

大阪府吹田市南吹田2丁目19番1号 住友特殊金属株式会社吹田製作所内

(72) 発明者 石尾 雅昭

大阪府吹田市南吹田2丁目19番1号 住友特殊金属株式会社吹田製作所内

(72) 発明者 松原 茂次

大阪府吹田市南吹田2丁目19番1号 住友特殊金属株式会社吹田製作所内

Fターム(参考) 5C015 EE07

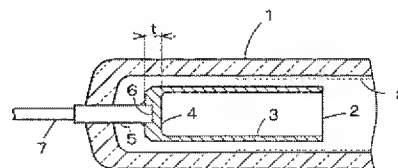
(54) 【発明の名称】 蛍光放電管用電極合金、蛍光放電管用電極およびその電極を備えた蛍光放電管

(57) 【要約】

【課題】ランプ輝度が向上し、成形加工性に優れた蛍光放電管用電極合金、蛍光放電管用電極、同電極を備えた蛍光放電管を提供する。

【解決手段】本発明による蛍光放電管用電極合金は、Wを2.0～10mass%含有し、残部実質的にNiからなるNi-W合金、あるいはWを2.0～6.0mass%およびNb、Taのいずれか一種または二種の元素を合計量で0.5～2.0mass%含有し、残部実質的にNiからなるNi-W-Nb合金、Ni-W-Ta合金あるいはNi-W-Nb-Ta合金によって形成される。本発明による蛍光放電管用電極2は、前記電極合金により形成され、一端が解放された管部3と、前記管部3の他端を閉塞する端板部4とを備える。前記端板部4が管部3の管壁厚さよりも厚く形成される。前記端板部4には管部3と同心状に給電用導電体位置決め用凹部6を形成することができる。

【選択図】 図1



【特許請求の範囲】

【請求項1】

Wを2.0～10mass%含有し、残部実質的にNiからなる蛍光放電管用電極合金。

【請求項2】

Wを2.0～6.0mass%、NbおよびTaから選択される1種または2種の元素を合計量で0.5～2.0mass%含有し、残部実質的にNiからなる蛍光放電管用電極合金。

【請求項3】

一端が解放された管部と、前記管部の他端を閉塞する端板部とを備えた蛍光放電管用電極であって、
前記管部と端板部とが請求項1または2に記載した電極合金によって一体的に成形され、
前記端板部が管部の管壁厚さよりも厚く形成された蛍光放電管用電極。

【請求項4】

前記端板部は、その外側に前記管部と同心状に配置された導電体位置決め用凹部が設けられた請求項3に記載された蛍光放電管用電極。

【請求項5】

内壁面に蛍光膜が形成され、その内部に放電用ガスが封入されたガラス管と、そのガラス管の両端部にガラス管と同心状かつガラス管の内外に貫通状に封止された給電用導電体と、前記ガラス管の内部に配置され、前記給電用導電体の端部に接続された一対の電極を備えた蛍光放電管であって、
前記電極として請求項3または4に記載された蛍光放電管用電極が用いられ、前記電極の端板部の外側に前記給電用導電体が同心状に溶着された、蛍光放電管。

【発明の詳細な説明】

【0001】

【発明が属する技術分野】

本発明は、例えば液晶のバックライトとして用いられる蛍光放電管、その電極および電極材に関する。

【0002】

【従来の技術】

液晶装置にはバックライトとして小形の蛍光放電管が用いられる。かかる蛍光放電管は、図3に示すように、内壁面に蛍光膜（図示省略）が形成され、その内部に放電用ガス（アルゴンガス等の希ガスおよび水銀蒸気）が封入されたガラス管11と、そのガラス管11の両端部に設けられた一対の冷陰極を構成する電極12を備えている。前記電極12は、一端が解放された筒状の管部13と、この管部13の他端を閉塞する端板部14とによって有底筒状に一体的に形成されている。前記端板部14には前記ガラス管11の端部を貫通するように封止された棒状の導電体15の一端が溶接され、この導電体15の他端にリード線17が接続される。

【0003】

前記電極12は、従来、純Niによって形成され、そのサイズは、バックライト等の小形の蛍光放電管用のものでは、例えば内径1.5mm程度、全長5mm程度、壁部13の肉厚0.1mm程度である。かかる筒状電極は、通常、前記管部の肉厚と同等の厚さを有する純Ni薄板を深絞り成形することによって一体的に成形される。

【0004】

蛍光放電管用電極に関する技術として、特開2002-110085号公報（特許文献1）には、ランプ寿命を向上させるために、電極をスパッタ率の低い、Nb、Ti、Ta又はこれらの合金で形成することが記載されている。しかし、これらの高融点酸化性金属は高価である上、プラズマーク溶解法や粉末冶金法など、通常の溶解・ casting法とは異なる特殊な方法によってバルク材を製造する必要がある、さらに純Niに比較して成形加工性が非常に悪く、純Niのように筒状電極に容易に成形加工することができないという問題がある。

【特許文献1】

特開2000-3973号公報(特許請求の範囲)

【0005】

【発明が解決しようとする課題】

上記のとおり、蛍光放電管用電極は、主として成形性が良好で、材質的にも安定な純Niによって形成されていたが、蛍光放電管の小形化に伴って、輝度の向上が求められている。輝度を向上させるには、放電管に封入された放電用ガス(希ガス)の圧力を下げればよいが、点灯の際に電極にイオン等が衝突して電極金属から原子を放出する現象(スパッタリング)が生じ易くなる。この結果、電極金属の原子がガラス管内に封入された水銀と結合し、水銀蒸気を消耗させるので、ランプ寿命が低下するという問題がある。

また、従来の筒状電極は端板部が筒状本体と同等の肉厚しかないので、給電用の導電体を溶接する際の溶接条件が厳しく、溶着不良が生じ易い。このため電極への電氣的、熱的接合が不確実となり、放電状態、放熱状態が不安定となり、蛍光放電管の輝度が低下し、またランプ寿命も低下し易くなるという問題がある。

本発明は、かかる問題に鑑みなされたもので、成形加工性に優れ、しかも放電管の輝度を向上させることができる蛍光放電管用電極合金を提供すること、また給電用導電体の溶着不良に起因する輝度の低下、ランプ寿命の低下を防止することができる蛍光放電管用電極を提供すること、さらに上記特徴を備えた蛍光放電管を提供することを目的とする。

【0006】

【課題を解決するための手段】

本発明による蛍光放電管用電極合金は、Wを2.0～10mass%含有し、残部実質的にNiからなるNi-W合金、あるいはWを2.0～6.0mass%およびNb、Taのいずれか一種または二種の元素を0.5～2.0mass%含有し、残部実質的にNiからなるNi-W-Nb合金、Ni-W-Ta合金あるいはNi-W-Nb-Ta合金によって形成される。

【0007】

この電極合金によれば、Niに電子放出特性に優れたWを適量含むので、純Niに対して実用上遜色のない成形加工性を確保しつつ、同様の放電条件の下で蛍光放電管の輝度を向上させることができる。また、Nb、Taの1種または2種を0.5～2.0mass%と僅かに添加することによって、電極のスパッタ率を低下させることができ、ランプ寿命が向上する。Nb、Taも成形加工性を劣化させ、その程度はWより2倍程度大きいので、これらの元素をWとともに複合添加する場合は、W量の上限は6.0%にする必要がある。

【0008】

また、本発明による蛍光放電管用電極は、一端が解放された管部と、前記管部の他端を閉塞する端板部とを備え、前記管部と端板部とが前記電極合金によって一体的に成形され、前記端板部が管部の管壁厚さよりも厚く形成される。

【0009】

この電極によれば、管部の管壁の厚さが薄い場合であっても、給電用導電体が溶着される端板部の厚さが管部の管壁の厚さよりも厚く形成されるので、前記導電体の端部を端板部に突き合わせ状に溶着する際、溶接出力などの溶着出力の微妙な制御を行うことなく導電体の端部を端板部に容易に溶着することができ、両者の溶着不良を防止することができる。このため、導電体と電極との電氣的、熱的接合が確実となり、放電状態、放熱状態が安定し、蛍光放電管の輝度やランプ寿命の低下を防止することができる。また、蛍光放電管の製造歩留まりを向上させることができる。

【0010】

前記電極において、前記端板部の外側に前記管部と同心状に配置された導電体位置決め用凹部を設けることが好ましい。かかる導電体位置決め用凹部を設けることによって、導電体の端部を前記凹部に差し込んで溶着するだけで、電極の端板部に導電体を同心状に確実に溶着することができる。このため、導電体をガラス管の端部に同心状に封止することに

より、電極とガラス管とが同心状に配置され、ガラス管内における放電状態の均一性、安定性が向上し、ランプ寿命をより向上させることができる。

【0011】

また、前記電極は上記本発明に係る電極用合金（Ni-W合金、Ni-W-Nb合金、Ni-W-Ta合金あるいはNi-W-Nb-Ta合金）で形成されるので、その電極合金の優れた成形加工性によって一体成形することができ、また電子放出特性の優れたWの作用によりランプ輝度を向上させることができる。

【0012】

また、本発明による蛍光放電管は、内壁面に蛍光膜が形成され、その内部に放電用ガスが封入されたガラス管と、そのガラス管の両端部にガラス管と同心状かつガラス管の内外に貫通状に封止された給電用導電体と、前記ガラス管の内部に配置され、前記給電用導電体の端部に接続された一対の電極を備えた蛍光放電管であって、前記電極として上記本発明にかかる蛍光放電管用電極が用いられ、前記電極の端部部の外側に前記給電用導電体が同心状に溶着されたものである。この蛍光放電管によれば、上記本発明にかかる電極による各効果を備える。

【0013】

【発明の実施の形態】

本発明の電極合金は、Wを2.0～10mass%含有し、残部Niおよび不可避的不純物からなるNi-W合金からなるものである。この合金には、W量を2.0～6.0mass%とし、Nb、Taの一種あるいは二種を合計量で0.5～2.0mass%含有することができ、Ni-W-Nb合金、Ni-W-Ta合金あるいはNi-W-Nb-Ta合金（以下、これらのNb、Taを含むNi-W合金も単にNi-W合金という場合がある。）とすることができる。

【0014】

電極を形成する金属元素の電子放出特性は、一般的に下記式（Richardson-Dushmanの式）で求められる飽和熱電子電流（ I_0 ）によって表され、 I_0 が大きいほど電子放出特性に優れる。下記式から明らかなように、 I_0 は仕事関数 ϕ 、絶対温度Tが一定であれば、ダッシュマン定数Aが大きいほど電子放出特性は向上する。仕事関数 ϕ についてはNiが4.5eV、Wが4.6eVとほぼ同等であり、ダッシュマン定数AはNiが30、Wが70である。これより、電子放出特性はWがNiの2倍以上あることがわかる。蛍光放電管、例えば液晶装置のバックライトの温度は一定（600℃）であるので、その温度におけるNi-W合金の電子放出量はNiより高く、W量が多いほどNi-W合金の電子放出量は増大し、輝度が向上する。W量が2.0%未満では輝度向上作用が過少であるので、本発明ではW量の下限を2.0%、好ましくは3.0%とする。

$$I_0 = AT^2 \exp(-\phi/kT)$$

但し、T：絶対温度、 ϕ ：仕事関数、k：ボルツマン定数

【0015】

一方、WはNiの成形加工性を低下させる。後述の実施例から明らかなように、W量が10%を超えると成形加工性が低下し、インパクト成形（冷間閉塞鍛造）によって筒状電極を一体成形することが困難になる。このため、W量の上限を10%、好ましくは8%とする。

【0016】

Nb、Taはスパッタ率を低下させ、ランプ寿命の向上に効果がある元素である。本発明者は、これらの元素をNi-W合金に僅かに添加するだけで、添加量に比してスパッタ率が大幅に低下することを知見した。Nb、Taの一種または二種の合計量が0.5%未満では、スパッタ率の低下作用が過少であるので、添加量（合計量）の下限を0.5%、好ましくは1.0%とする。一方、発明者の実験によると、これらの元素はWに比して2倍程度成形加工性を劣化させ、添加量が2.0%を超えると、Wを複合添加する場合、成形加工性の劣化が著しくなる。このため、添加量（合計量）の上限を2.0%、好ましくは1.5%とする。Nb、Taを添加する場合、これらの元素による成形加工性の劣化を考

慮して、W量の添加の上限を6.0%、好ましくは5.0%とする。なお、後述の実施例から明かなように、Taの方がNbよりもスパッタ率の低減効果は大きい。

【0017】

前記電極合金は、高融点の難加工性元素を含むものの、純Niと同様、成形性、加工性に極めて優れるので、大気下で鋳造した後、その鋳造片を大気下で熱間圧延し、必要に応じて不活性雰囲気下で焼鈍した後、冷間圧延することにより0.1mm程度のシートに容易に加工することができる。そして、必要に応じて仕上焼鈍（軟化焼鈍）した後、前記シートを絞り成形することによって、筒状電極を製造することができる。また、鋳造片を熱間圧延や熱間鍛造によって棒材に加工し、これを伸線し、得られた線材を適宜の長さに切断して短軸状素材（スラグという。）を得て、必要に応じて仕上焼鈍した後、これをインパクト成形することによって筒状電極を得ることができる。インパクト成形する場合、筒状電極の端板部の板厚を筒状部に比して容易に厚くすることができ、さらにまた端板部に導電体位置決め用の凹部を容易に一体成形することができ、生産性に優れる。なお、仕上焼鈍は、800～950℃程度で3min から3hr程度保持すればよい。焼鈍雰囲気は、Nb、Taを含まないNi-W合金では水素ガス雰囲気中で行えばよいが、Nb、Taを含む場合は、これらの元素は酸化および窒化し易いので、真空雰囲気あるいはAr等の不活性ガス雰囲気中で行うことが好ましい。

【0018】

次に、本発明の実施形態にかかる蛍光放電管およびその電極について説明する。図1は、実施形態にかかる蛍光放電管の要部断面図であり、この蛍光放電管は、内壁面に蛍光膜8が形成され、放電用ガス（アルゴンガス等の希ガスおよび水銀蒸気）が封入されたガラス管1と、そのガラス管1の両端部に設けられた一対の冷陰極を構成する電極2を備えている。

【0019】

前記電極2は、一端が解放された管部3と、この管部3の一端を閉塞する端板部4とが一体的に形成されている。前記端板部4には、給電用の棒状の導電体5と前記管部3とが同心状に配列されるように、前記導電体5の一端が嵌合される導電体位置決め用凹部6が形成されている。前記導電体5は、ガラス管1の端部を内外に貫通するように封止され、ガラス管1の内側の端部が前記凹部6に嵌合され、端板部4との境界外周部においてレーザ溶接、抵抗溶接、ろう付けなどによって溶着されている。前記ガラス管1の外側に位置する、前記導電体5の他端には給電用のリード線7が接続される。

【0020】

前記端板部4の厚さ（導電体5が溶着される部位の厚さ）は、前記凹部6を形成するとともに導電体5を端板部4に十分溶着することができるように、前記管部3の管壁の肉厚よりも厚く形成されている。小形の蛍光放電管では、電極2の長さは4～10mm程度、管部3の肉厚は0.08～0.2mm程度に形成され、前記端板部4の厚さは前記管部3の肉厚の3～10倍程度に形成される。なお、端板部4における凹部6の深さは管部3の管壁厚さ以上、好ましくは管壁厚さの2倍以上とするのがよく、また凹部6の底面と管部側内面との肉厚は管壁の肉厚程度以上あればよい。

【0021】

前記電極2は、純Niで形成することができるが、前記電極用Ni-W合金で形成することが好ましい。前記Ni-W合金を用いることにより、純Niと同等程度の冷間成形性を有するとともに、蛍光放電管の輝度を向上させることができる。さらに、Nb、Taを含む場合は、スパッタ率を低減することができ、ランプ寿命を向上させることができる。この筒状電極は、インパクト成形によって一体成形される。

【0022】

上記実施形態では、導電体位置決め用凹部6が端板部4に一体成形された例を示したが、前記凹部6は必ずしも必要としない。もっとも、前記凹部6を形成することによって、導電体5と電極2の管部3とが同心状に配置されるので、前記導電体5をガラス管1に同心状に封止することによって、電極2とガラス管1とを同心状に容易に配置することができ

、放電状態の不均一化を防止することができ、放電の安定化、ランプ寿命の向上を図ることができる。

【0023】

以下、実施例を挙げて本発明をより具体的に説明するが、本発明はかかる実施例によって限定的に解釈されるものではない。

【0024】

【実施例】

表1に示す組成のNi-W合金を真空誘導炉にて1500℃にて溶解し、その溶湯を鑄造した鑄造片を大気中で1100℃で熱間鍛造した後、圧延開始温度1100℃で熱間圧延を行い、熱延板および熱延線材を得た。これらの熱延材は窒素および水素の混合ガス（大気圧）中で焼鈍（900℃で2hr保持）され、冷間圧延および冷間伸線が施され、板厚0.1mmの薄板、外径1.7mmφの線材に加工された。これらの試料を用いて加工性およびスパッタ率が測定された。

【0025】

加工性は、Nb、Taを含まないNi-W合金についてはインパクト成形試験および圧縮試験によって評価した。また、Nb、Taを含むNi-W合金のインパクト成形性については圧縮試験結果によって評価した。

【0026】

インパクト成形試験は、前記線材を1.8mmの長さのスラグに切断し、仕上焼鈍（真空雰囲気下、900℃で2hr保持）後、これを用いて図2に示す、内径1.5mmφ、外径1.7mmφ、全長5.4mm、導電体位置決め用凹部深さ0.2mmの筒状電極を実際に成形することによって行われた。用いた成形型のパンチは、外径1.5mmφ、先端部開き角150°、材質ダイス鋼（SKD11）である。一方、ダイは、内径は1.7mmφ、材質超硬合金（D種6号）である。インパクト成形性の評価は、成形回数が1000ショットに到達する前あるいは到達時点でダイが破損し、あるいはパンチが変形したため、成形が出来なくなったものを成形不可（×）、前記ショット数に到達した時点でダイの破損やパンチの変形が生じず、さらに成形可能であったものを成形可能（○）とした。

【0027】

圧縮試験は、前記スラグの軸方向に1470MPa（150kgf/mm²）の荷重を付加し、下記式により圧縮率（％）を求めた。

圧縮率＝（加圧後のスラグ長さ）／（加圧前のスラグ長さ）×100

【0028】

また、スパッタ率は以下の要領により測定された。Ni合金薄板から試験片（10mm×10mm）を採取し、試験面を鏡面研磨した。イオンビーム装置（Veeco社製、型式：VE-747）を用いて、前記試験片をターゲットとし、ターゲットと基板との間に電圧（500V）を印加し、一定時間（30min）アルゴンイオン（ 1.3×10^{-6} Torr）を試験面に加速衝突させ、スパッタリングした。試験面には鏡面の一部をマスクングした非スパッタ部が形成されており、スパッタリング後には、スパッタリングによって試験片の鏡面部が削られたスパッタ部とマスクングされた非スパッタ部との境界に段差が形成される。この段差を接触式粗度計（ Sloan社製、型式：DEKTAK 2A）を用いて測定し、下記式からスパッタ率（％）を求めた。

スパッタ率＝段差（Å）／スパッタ時間（30min）×100

【0029】

以上のようにして求めた圧縮率、インパクト成形性、スパッタ率を表1に併せて示す。なお、比較のため、純Niのバルク材を準備し、これを用いて上記と同様の条件でスパッタリングすることによって求めたスパッタ率も併せて示す。

【0030】

【表1】

試料 No.	組 成 mass%				圧縮率 %	インパクト 成形性	スパッタ率 %	備 考
	W	N b	T a	N i				
1	1.0	—	—	残	50	○	218	比較例
2	2.0	—	—	残	50	○	217	発明例
3	4.0	—	—	残	50	○	196	"
4	6.0	—	—	残	52	○	210	"
5	8.0	—	—	残	53	○	208	
6	10.0	—	—	残	55	○	205	"
7	12.0	—	—	残	57	×	210	比較例
8	5.0	1.0	—	残	54	(○)	185	発明例
9	5.0	—	1.0	残	53	(○)	130	"
10	4.0	0.7	0.7	残	55	(○)	145	"
11	—	—	—	100	—	—	214	比較例

【0031】

表1より、試料No. 1～8のNi-W合金の各試料によると、W量が10.0%以下では、小形筒状電極に対するインパクト成形性に優れる。スパッタ率は純Nbと同等程度であるが、Nb、Taを僅かな添加した試料No. 8～10では、純Niに対して10%以上低下していることが分かる。また、試料No. 8～10のNb、Taを含むNi-W合金では、その圧縮率は55%以下であり、試料No. 1～7の圧縮率とインパクト成形性との関係から、これらの試料においても優れたインパクト成形性を期待することができる。

【0032】

【発明の効果】

本発明の電極合金は、NiにWを1.0～10%含有させたものであり、インパクト成形等に対する成形加工性を損なうことなく、純Niに比して蛍光放電管の輝度を向上させることができる。また、Wが1.0～6.0%の下でさらにNb、Taを僅かに含有させることにより、前記Ni-W合金の特性を備え、さらにスパッタ率を添加量に比して大幅に低下させることができ、ランプ寿命を改善することができる。また、本発明の電極は、端板部の厚さが管部の管壁厚さより厚く形成されているので、給電用導電体の溶着が容易になり、電極への電氣的、熱的接合が確実となり、放電状態、放熱状態が安定し、蛍光放電管の輝度、ランプ寿命の低下を防止することができ、また蛍光放電管の製造歩留まりを向上させることができる。

【図面の簡単な説明】

【図1】本発明の実施形態にかかる蛍光放電管用電極を備えた蛍光放電管の要部断面図である。

【図2】本発明の実施例においてインパクト成形した蛍光放電管用電極の断面図である。

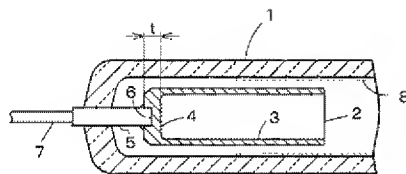
【図3】従来の蛍光放電管用電極を備えた蛍光放電管の要部断面図である。

【符号の説明】

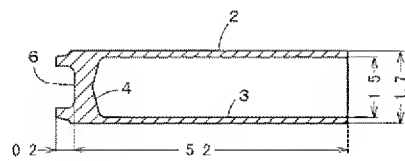
- 1 ガラス管
- 2 電極
- 3 管部
- 4 端板部
- 5 導電体

6 導電体位置決め用凹部

【図1】



【図2】



【図3】

